Nyanza Chemical Superfund Site
Sudbury River (OU4)

Public Informational Meeting
EPA's Proposed Clean up Plan

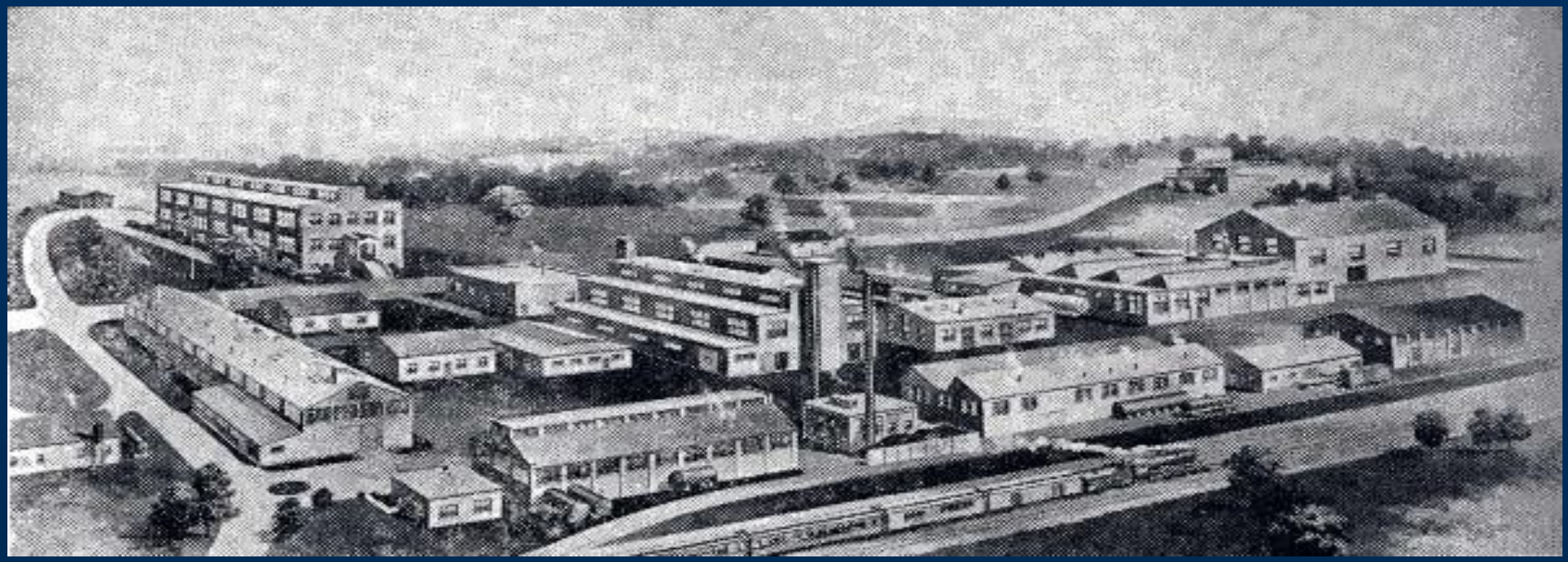
June 2010

Meeting Outline

- Site History
- Mercury Facts
- Mercury Distribution
- Risk Assessments
- WASP Computer model
- Alternatives evaluated
- Clean-up criteria
- EPA's preferred plan
- Public Participation
- Q &A

Nyanza – History

- Nyanza Chemical operated on a 35-acre parcel located on Megunko Road in Ashland 500 feet south of the Sudbury River. Nyanza operated from 1917 to 1978 manufacturing textile dyes and dye intermediates.



Nyanza - History

- From 1940 – 1970, greater than 100,000 lbs of mercury were released to the Sudbury River
- From 1970-1978, on-site treatment reduced discharges to 400 lbs
- 1983 – “Nyanza Chemical Waste Dump” added to the National Priorities List (or “NPL” or “**Superfund**”).

EPA Operable Units (OUs)

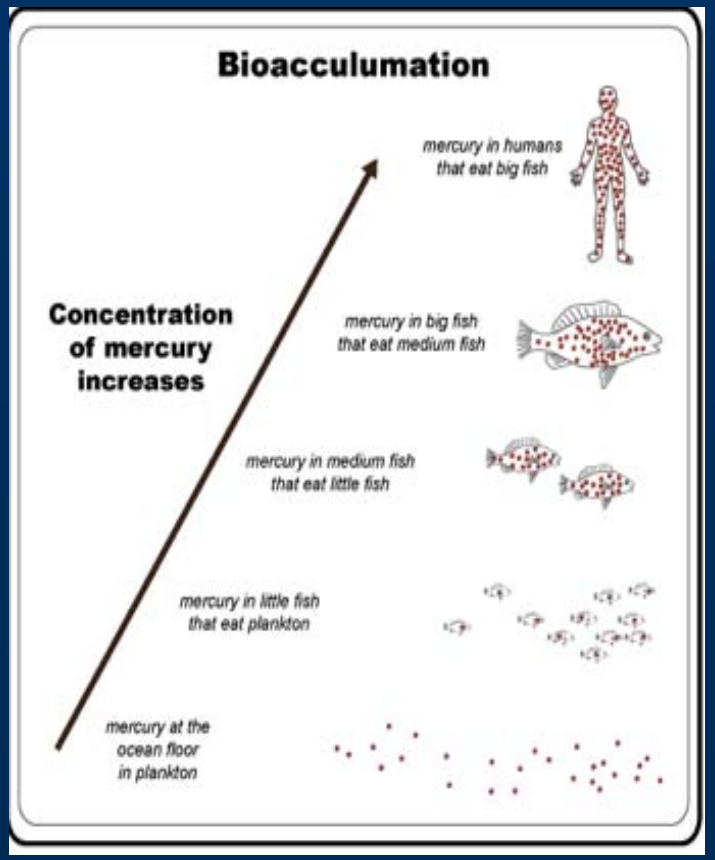
Nyanza Chemical consists of four Operable Units (or “OUs”):

- OU1 - On-site soil remediation/capping **(complete)**
- OU2 - Groundwater contamination/Indoor Air (on-going)
- OU3 - Eastern Wetlands/Trolley Brook (**complete**)
- **OU4 – Sudbury River Assessment (on-going)**

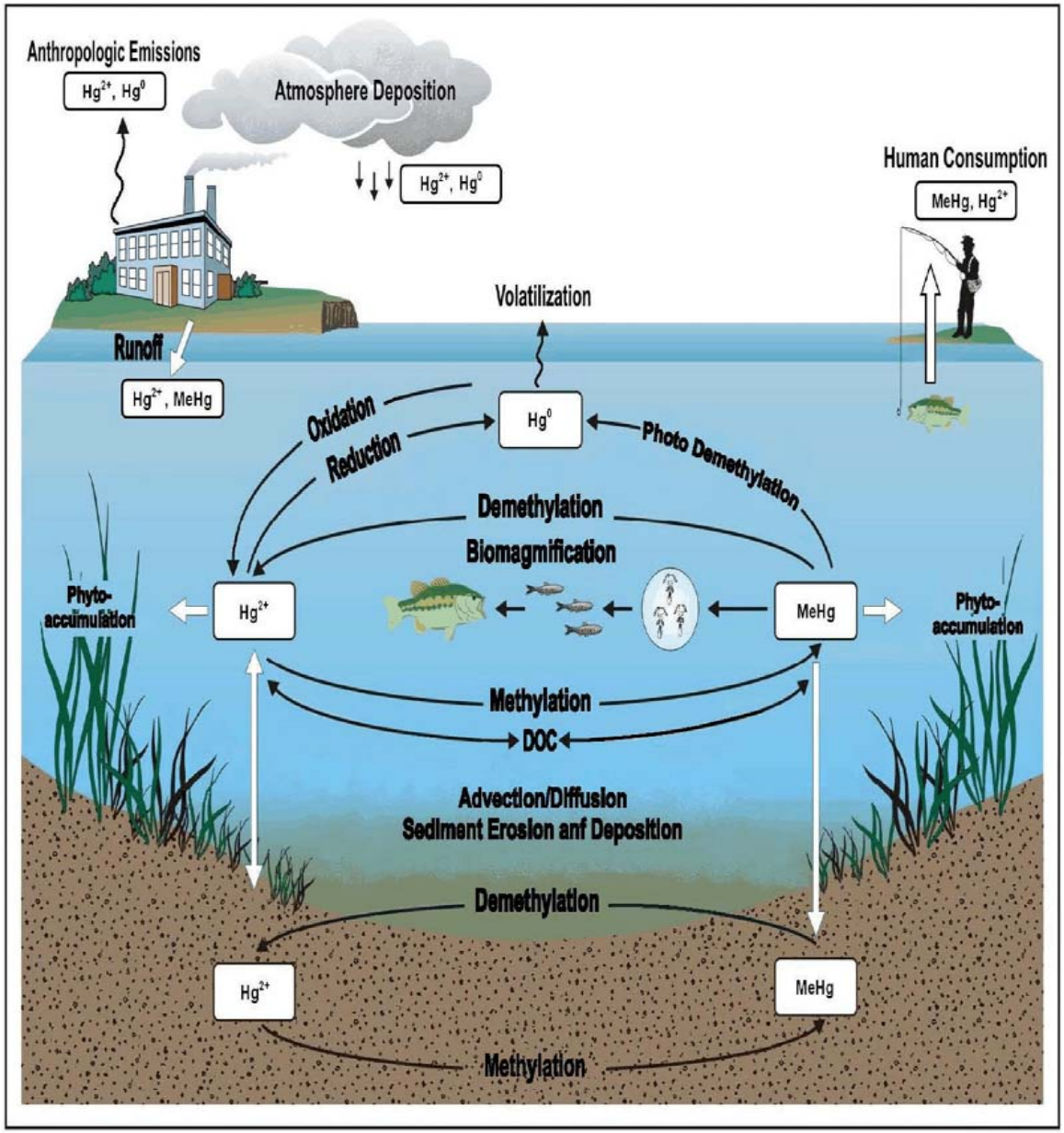

Sudbury River Watershed
Inset Scale in Miles
REACH 10
REACH 9
REACH 8
REACH 7
REACH 6
REACH 5
REACH 4
REACH 3
REACH 2
REACH 1
SECONDARY AREAS
PRIMARY AREA
NYANZA SUPERFUND SITE
CONCORD
SUDBURY
MARLBOROUGH
FRAMINGHAM
WAYLAND
NATICK
SHERBORN
ASHLAND
SOUTHBOROUGH
WESTBOROUGH
NORTHBOROUGH
HOPKINTON
MIDDLESEX CO
WORCESTER CO
Concord River
Assabet River
Sudbury River
Walden Pond
Fairhaven Bay
Farm Pond
Willis Lake
Carding Mill Pond
Hager Pond
Sudbury Reservoir
Hop Brook
Heard Pond
Dudley Pond
Saxonville Pond
Lake Cochituate
Res.B3
Res.B1
Res.B2
Mill Pond
Wanshacum Pond
Cedar Swamp Pond
Indian Brook
Hopkinton Reservoir
Ashland Reservoir
Westborough Reservoir
Whitehall Reservoir
Charles River
LEGEND:
Township Boundary
County Boundary
Watershed Boundary
Sudbury River Watershed
Hydrography
Target Areas
Primary
Secondary
River Reaches
Scale in Feet
Scale in Miles
Nyanza Superfund Site OU IV
Sudbury River Mercury Contamination
REACHES AND SUDBURY RIVER TARGET AREAS

Mercury Facts

- Multiple sources (point and non-point)
- Can exist in different forms
- Methylmercury capable of "bioaccumulating"
- Bioaccumulation is used to describe the increase in concentration of a substance in an organism over time.



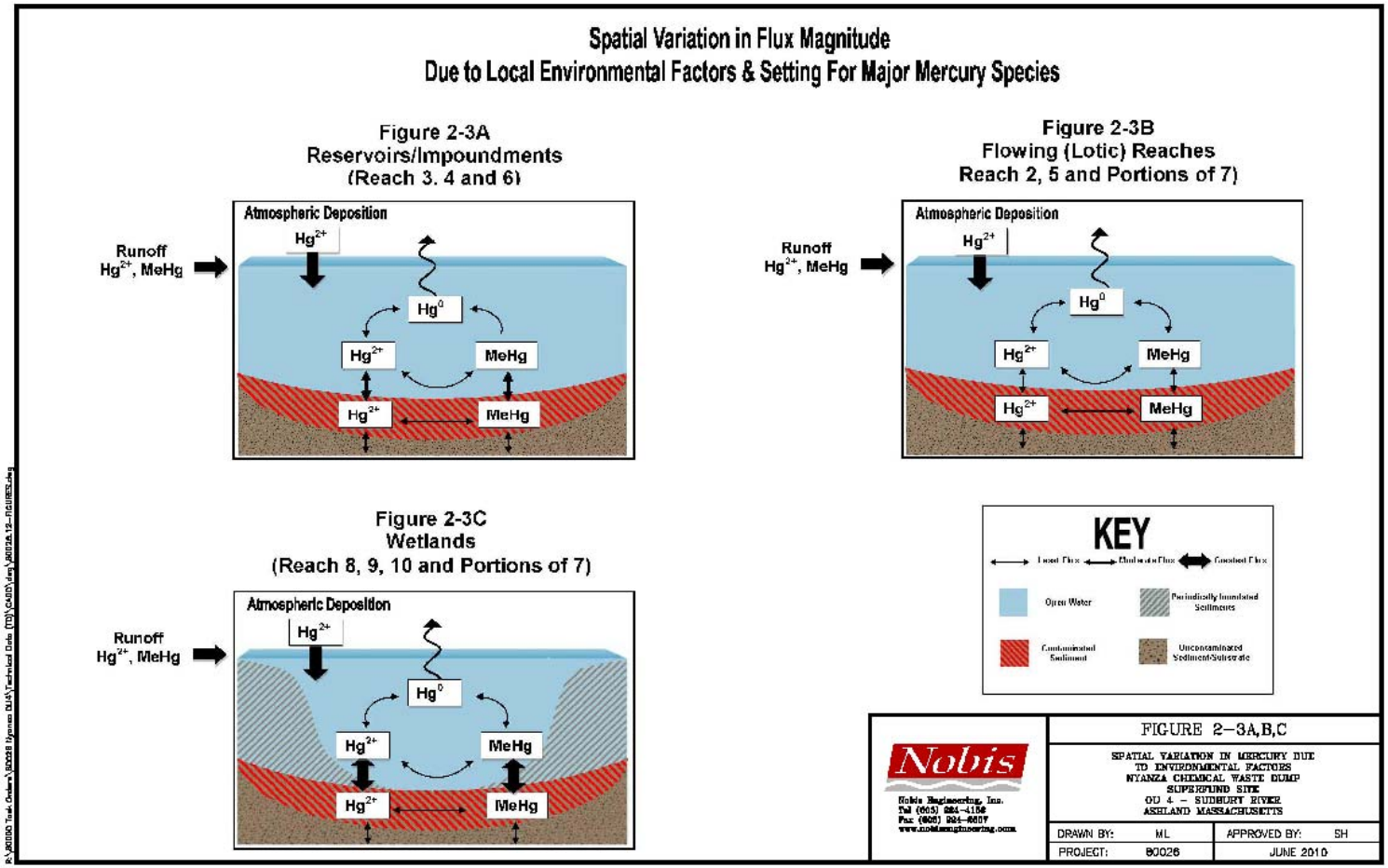
Mercury Cycling Within the Environment



Mercury Methylation

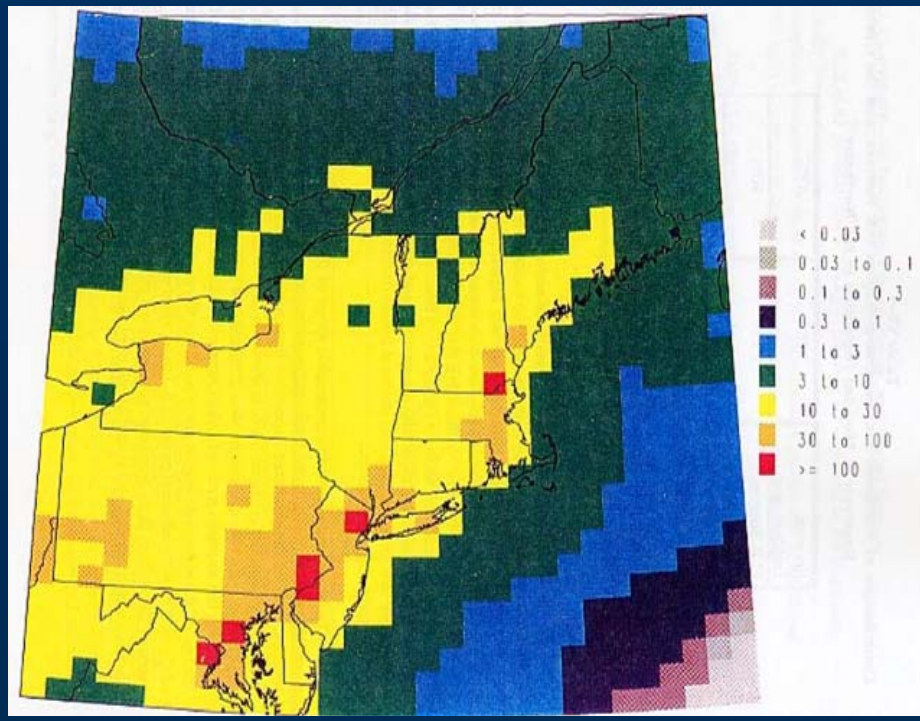
- Mercury methylation is important because it controls how much mercury enters the food web
- The rate of methylation is very dependent on hydrological factors.
- Seasonally-flooded wetlands [such as GMNWR] wetlands are very efficient at methylating mercury *(Kelly, C.A., et.al)*

Different Methylation Rates



Mercury – where does it come from?

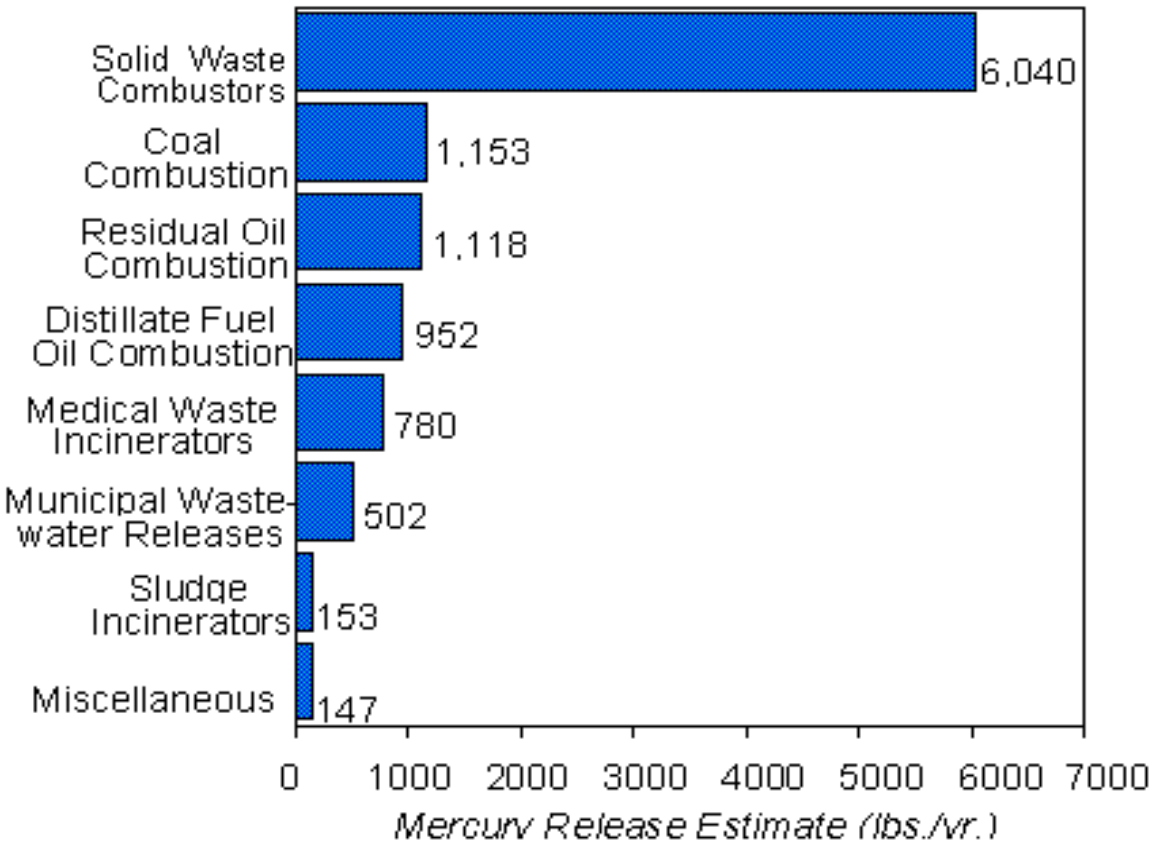
- Non-point ("diffuse") sources
  - Municipal waste incinerators
  - Power generating facilities



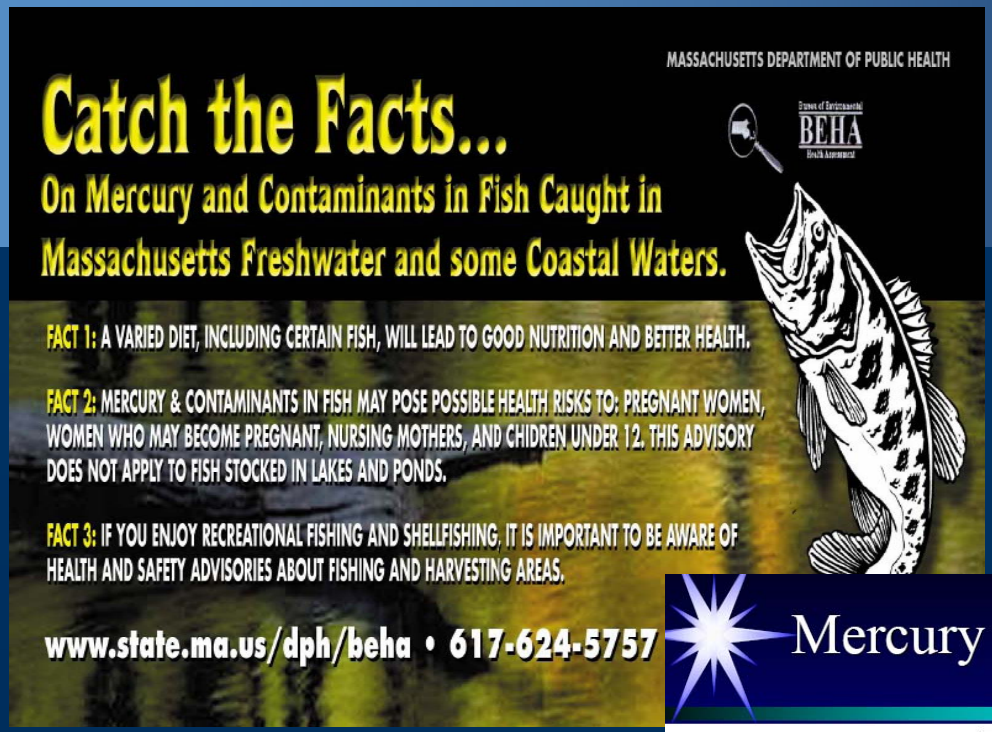
Mercury – where does it come from?

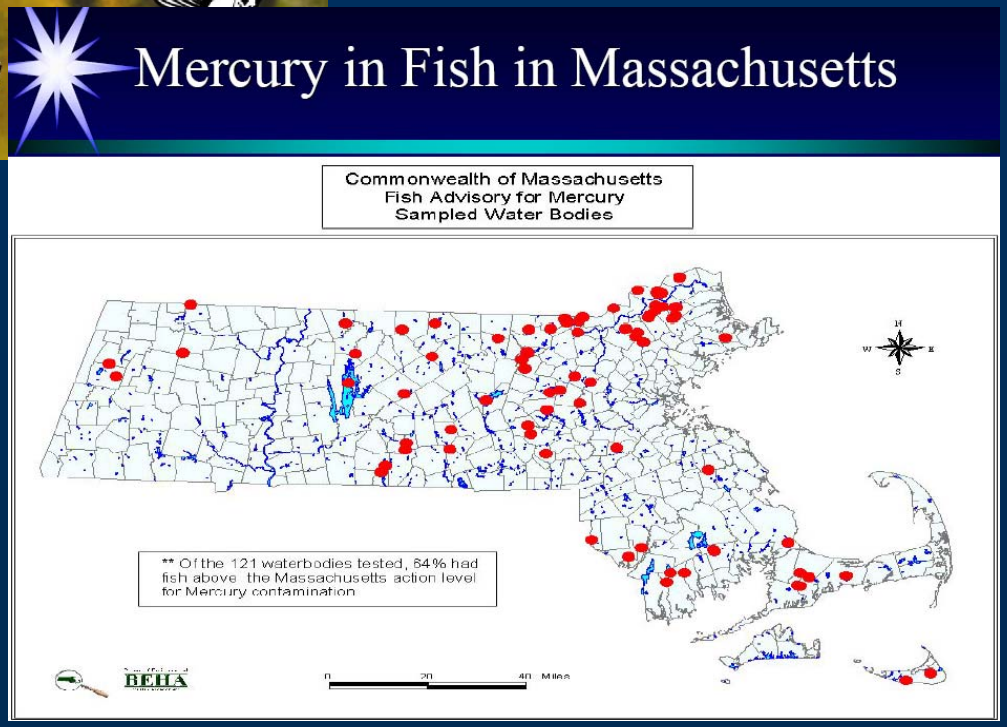
FIGURE 2

Summary of Mercury Releases in Massachusetts



The last category Includes lamp breakage, cremations, dental applications, commercial wood burning and lab uses. All values presented are DEPs current best estimates. Ranges of potential values are noted in the main body of the report (Chapter 3).


MASSACHUSETTS DEPARTMENT OF PUBLIC HEALTH
Catch the Facts...
On Mercury and Contaminants in Fish Caught in Massachusetts Freshwater and some Coastal Waters.
BEHA
FACT 1: A VARIED DIET, INCLUDING CERTAIN FISH, WILL LEAD TO GOOD NUTRITION AND BETTER HEALTH.
FACT 2: MERCURY & CONTAMINANTS IN FISH MAY POSE POSSIBLE HEALTH RISKS TO: PREGNANT WOMEN, WOMEN WHO MAY BECOME PREGNANT, NURSING MOTHERS, AND CHIDREN UNDER 12. THIS ADVISORY DOES NOT APPLY TO FISH STOCKED IN LAKES AND PONDS.
FACT 3: IF YOU ENJOY RECREATIONAL FISHING AND SHELLFISHING, IT IS IMPORTANT TO BE AWARE OF HEALTH AND SAFETY ADVISORIES ABOUT FISHING AND HARVESTING AREAS.
www.state.ma.us/dph/beha • 617-624-5757

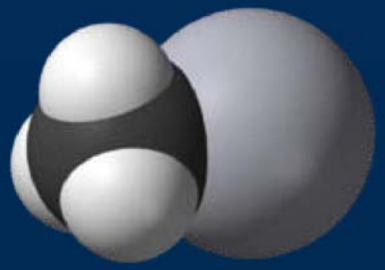

Mercury in Fish in Massachusetts
Commonwealth of Massachusetts
Fish Advisory for Mercury
Sampled Water Bodies
** Of the 121 waterbodies tested, 64% had fish above the Massachusetts action level for Mercury contamination
BEHA
0
20
40 Miles

Mercury Conclusions

1. Have multiple sources of mercury to the Sudbury River

2. Within the Sudbury River - different “reaches” have a different ability to make mercury “available” (i.e. methylated)

3. Wetlands are known to have **greatest** methyl-mercury production

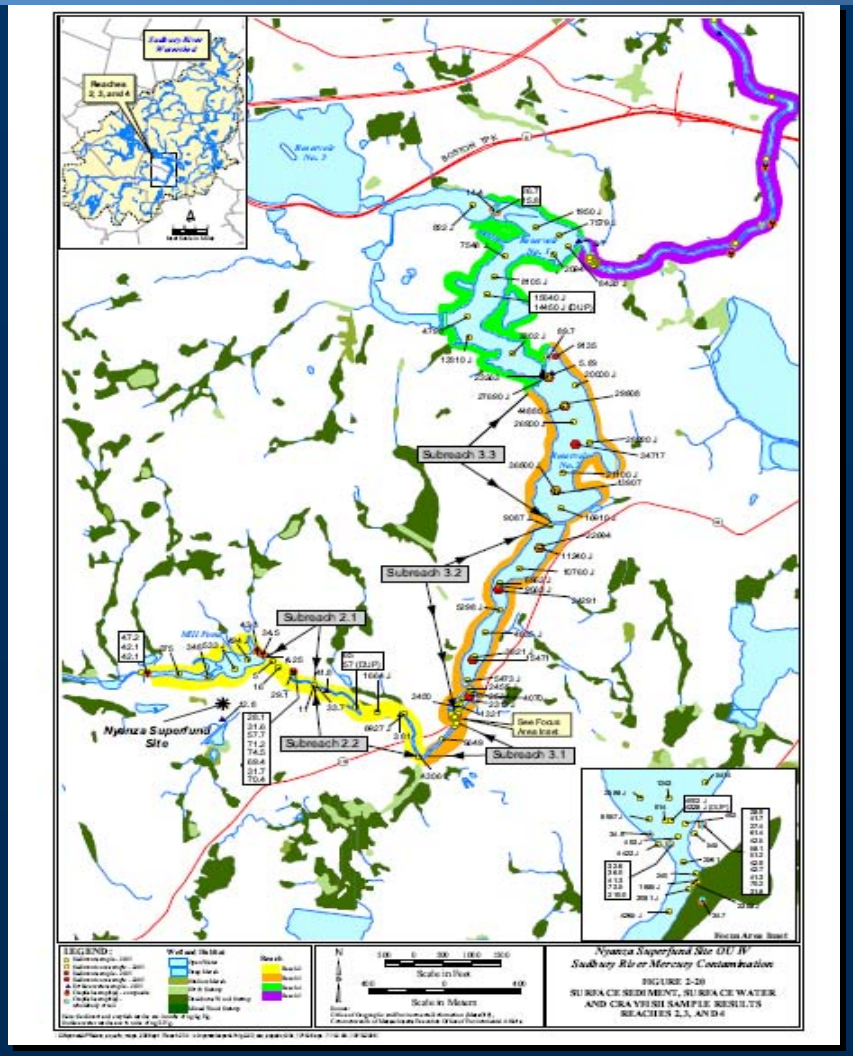


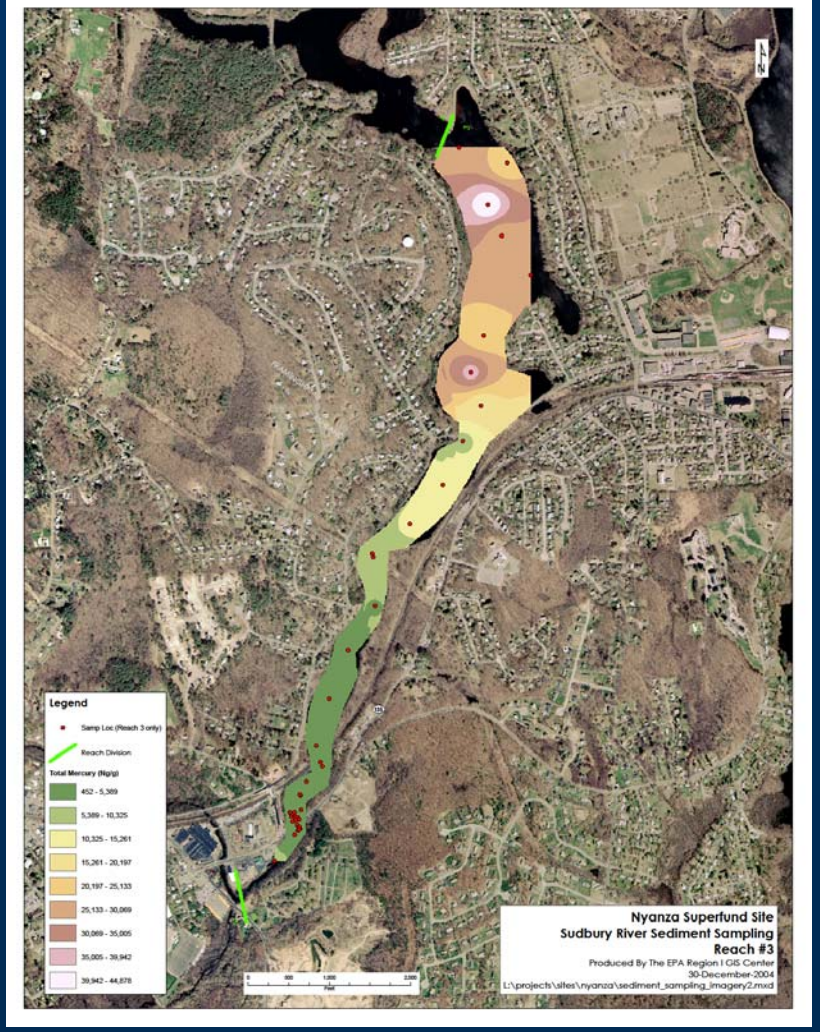
Questions

Nyanza Investigations

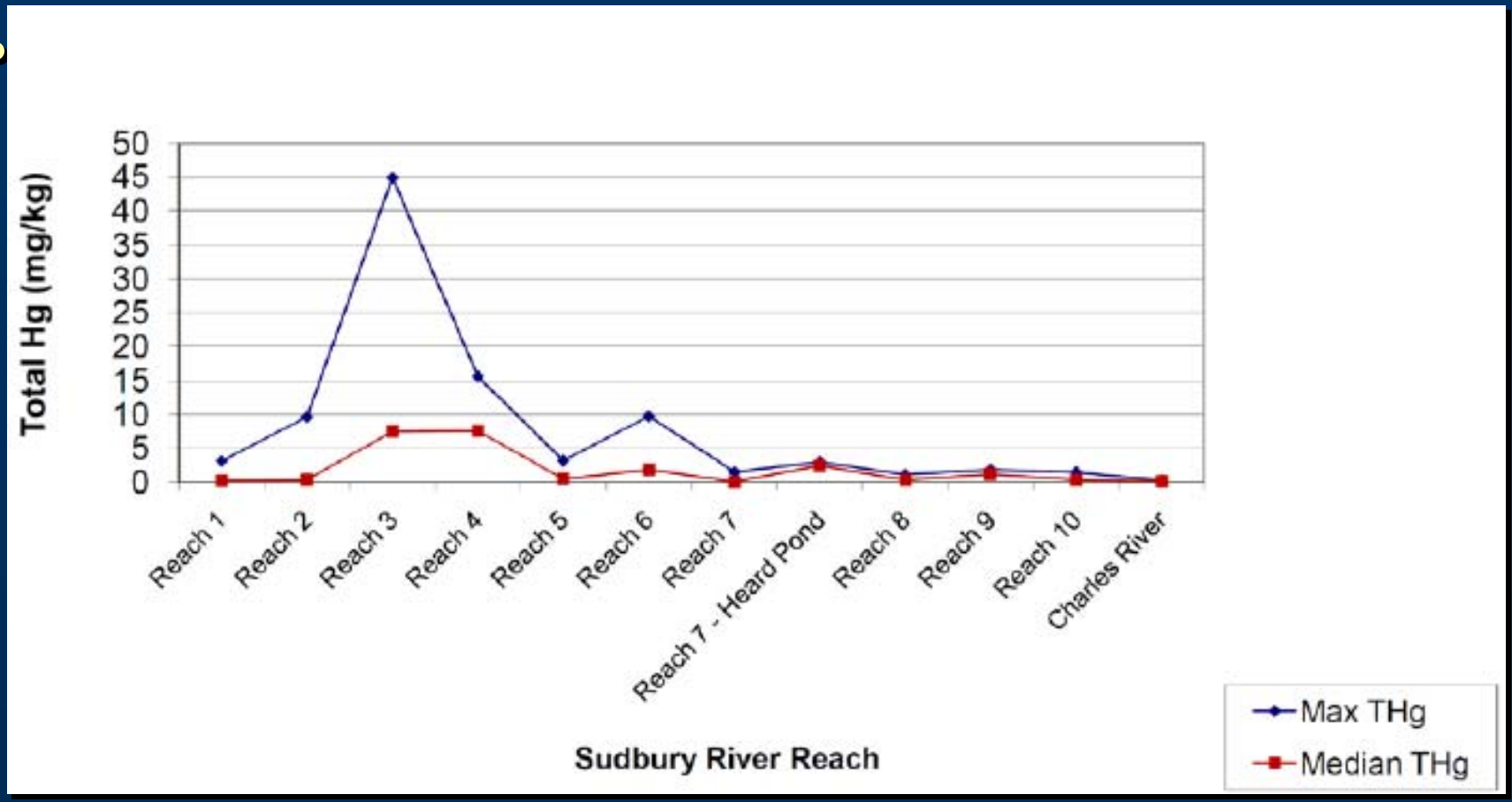
- Numerous investigations since the creation of OU4 in 1993:
  - 1995 - 1997 Nyanza Task Force Studies
  - 1999 Human Health Risk Assessment
  - 1999 Baseline Ecological Risk Assessment
  - 2003-2005 Site-wide comprehensive sampling
  - 2006 Supplemental Human Health Assessment
  - 2008 Supplemental Ecological Risk Assessment
  - 2010 Public Comment Draft Feasibility Study

Mercury Distribution

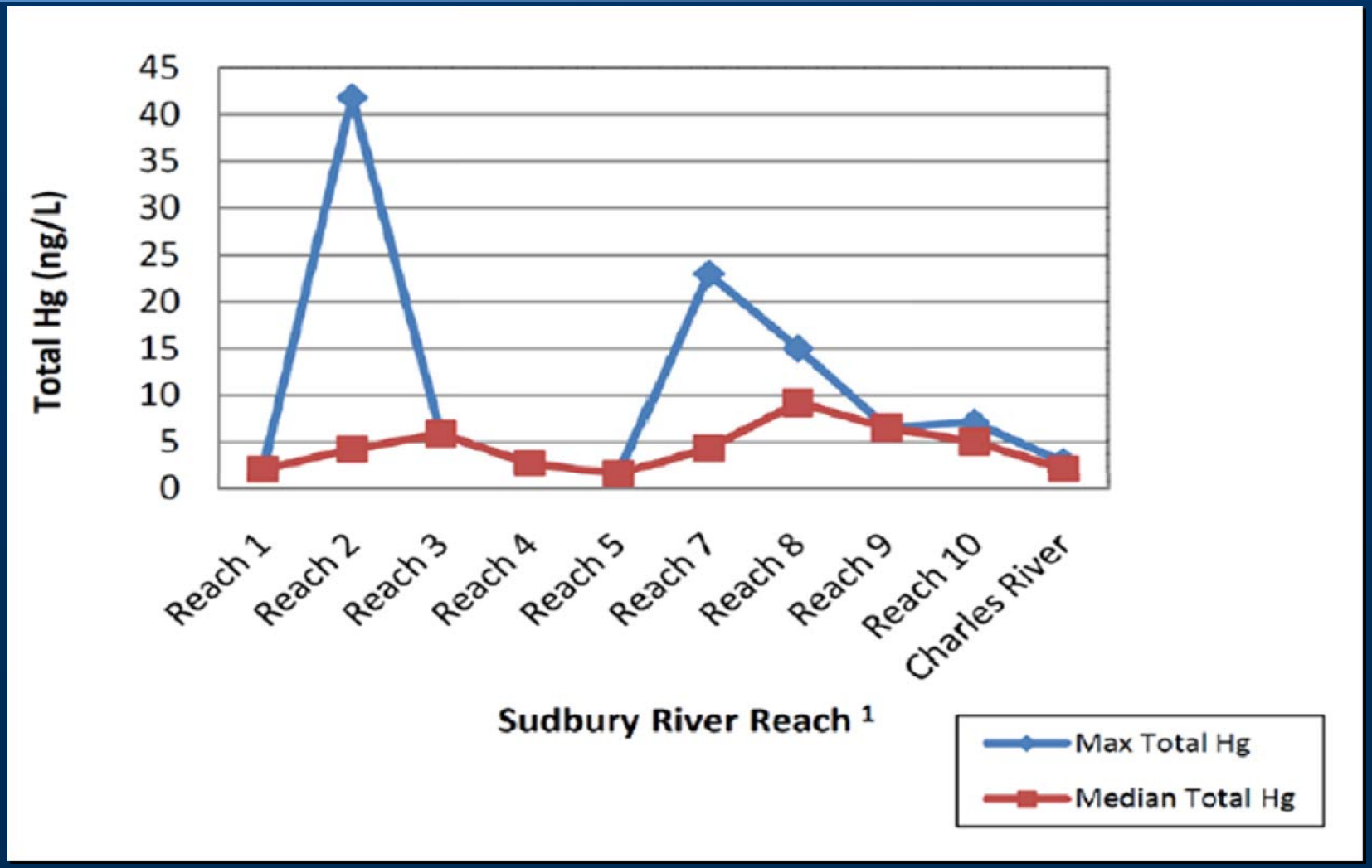




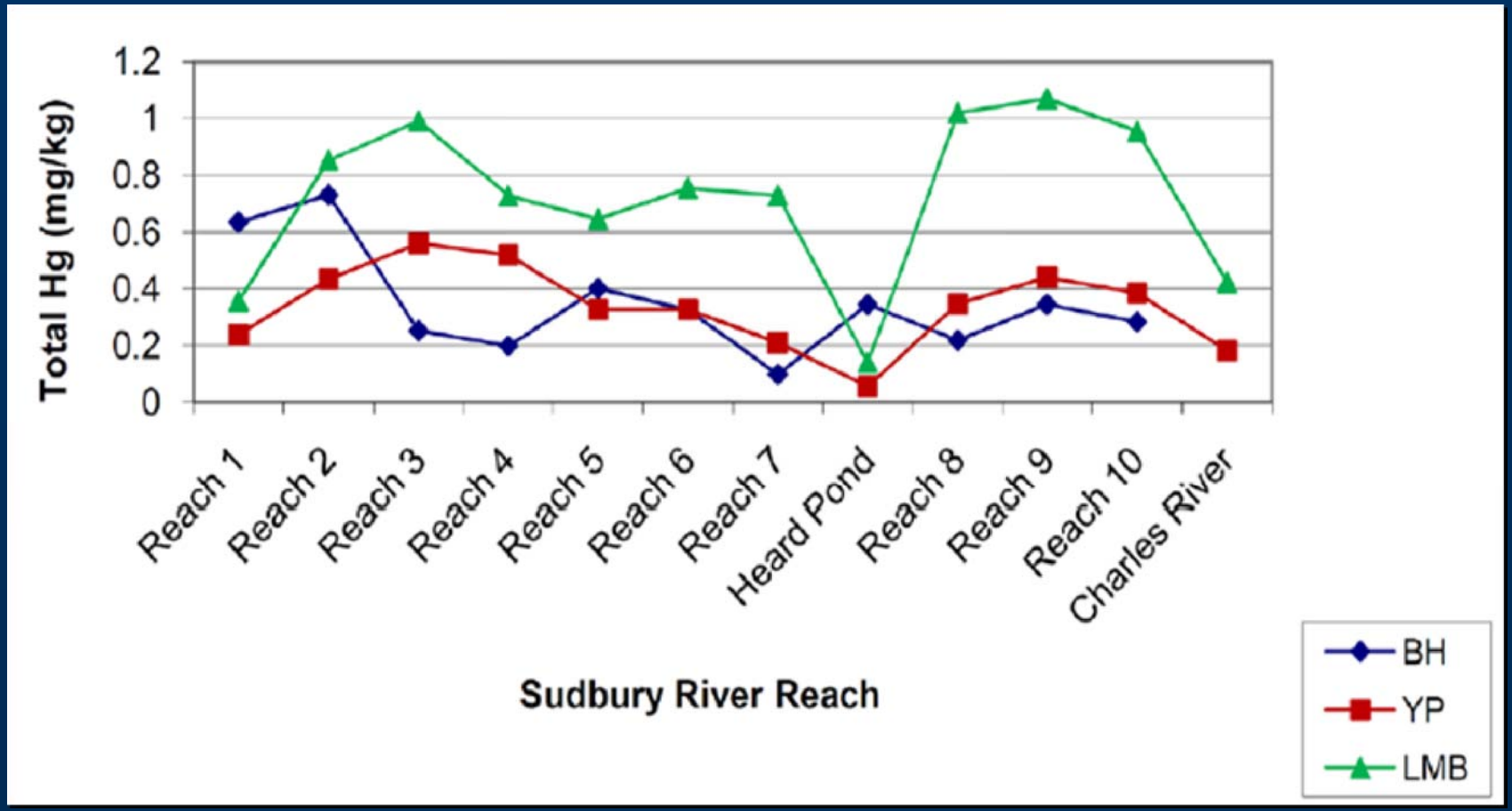
Mercury Distribution - Sediment



Mercury Distribution - Water



Mercury Distribution - Fish



Risks Assessments

- Multiple Human Health Risk Assessments
  - Mercury the only chemical of concern (due to its persistence and ability to accumulate)
  - No adverse health effects from contact or ingestion of Surface Water or Sediment
  - Health effects attributable to consumption of mercury-contaminated fish
  - Clean-up alternatives focused on protection of a Recreational Fisherman

Human Health Risks from Fish Consumption (2008)

Reach	Recreational Angler	
	Child	Adult
Reach 2 -	1.8	
Reach 3 – Res 2	2.1	1.2
Reach 4 – Res 1	1.3	
Reach 5		
Reach 6 - Saxonville	1.3	
Reach 7		
Reach 7 – Heard Pond		
Reach 8 – Great Meadows	1.3	
Reach 9	1.5	
Reach 10	1.4	

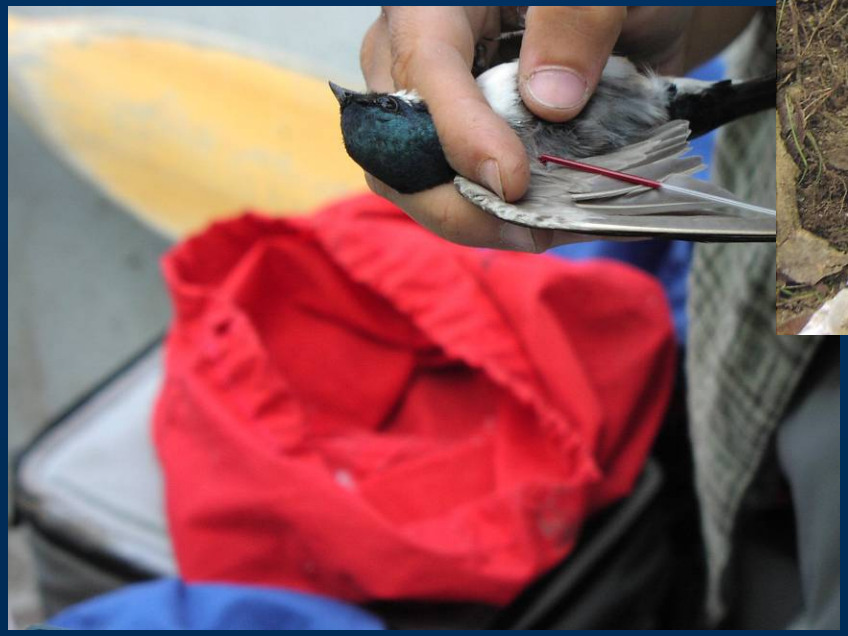
Ecological Assessment Update

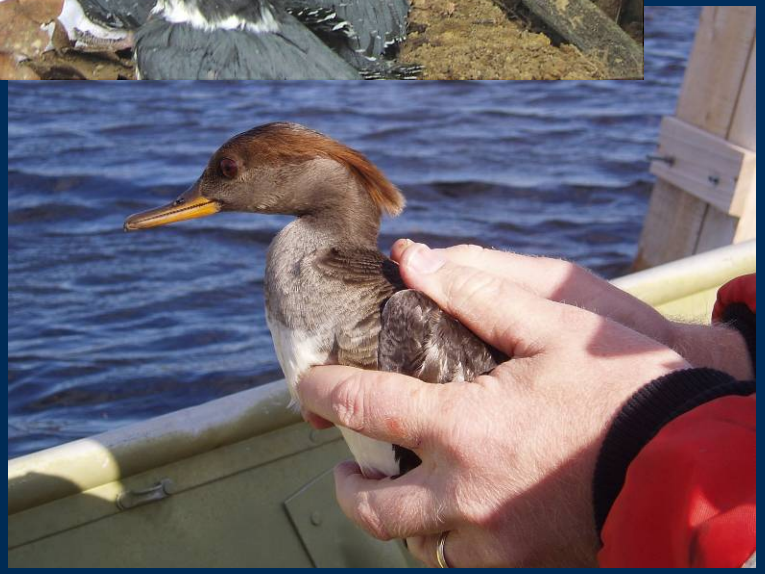
- Ecological Risk Assessment (December 2008)
- 229 *Measurement Endpoints* –
  - combination of food chain modeling results and site-specific/species-specific measurements
- Measurement endpoint = species x media (blood, egg, feather, fur) x reach
  - More weight given to site-specific measurements over modeling

Fish

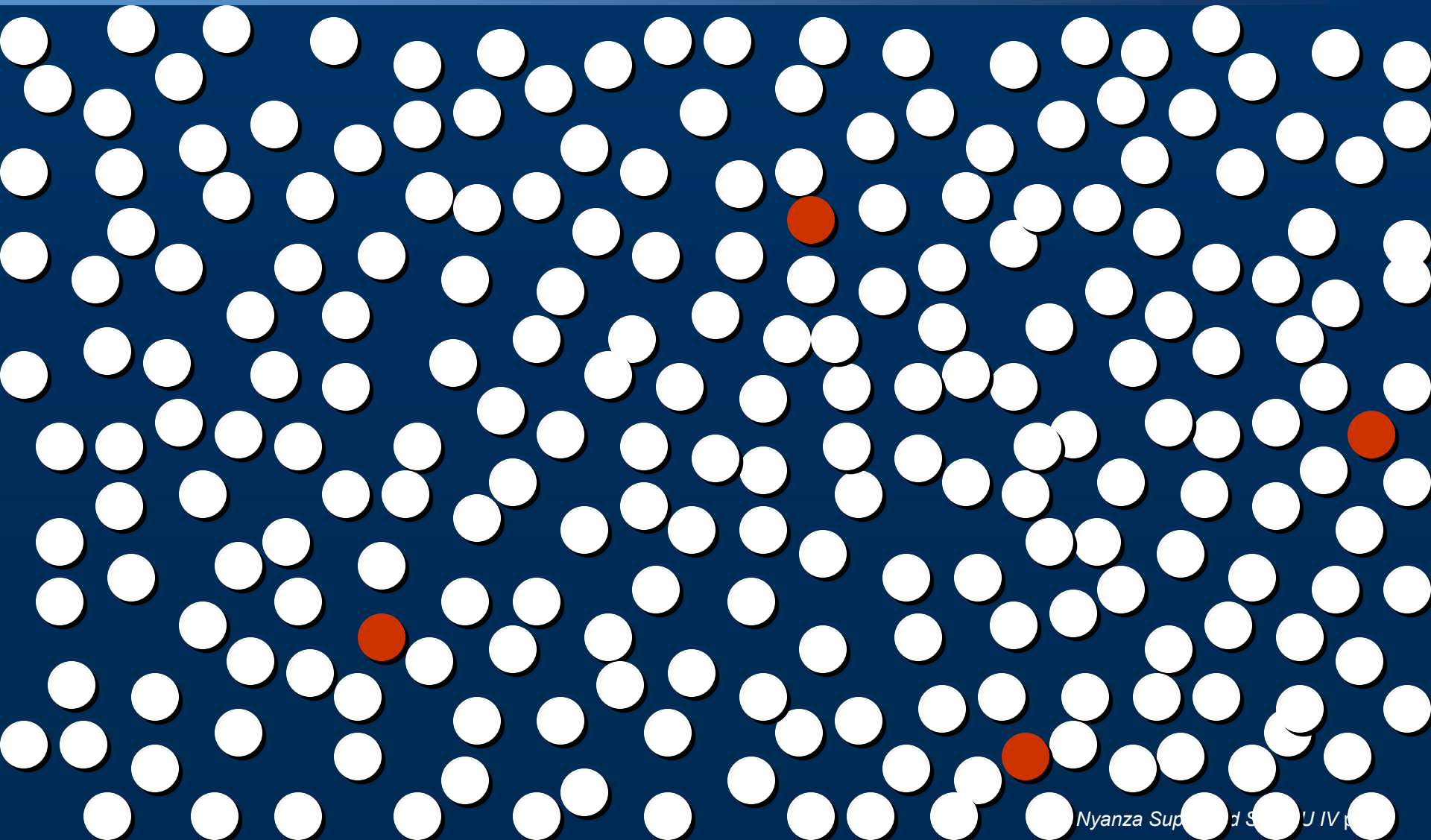
Crayfish , Mink

Avian Study





229 Measurement Endpoints



Weight of Evidence

- 225 endpoints did not indicate risk
- Remaining 4 include:
  - Benthic food-chain modeling (superseded by direct measurement)
  - Merganser Eggs (also in 3 out of 4 reference areas)
  - Large fish (>20 cm) a few (<10%) exceeded low effects level for reproduction
  - Redwing black bird caught as “by-catch”
- Conclusion: **No population–level ecological risk**

Questions

FS Highlights

- “Active” clean up alternatives focused on those areas with clearly elevated mercury in sediment (Reach 3,4, and 6)
- Developed Remedial alternatives based on two target concentrations: 2 and 10 ppm
- Reservoir 2 (Reach 3) has the only concentrations of total Hg above 10 ppm.
- WASP Computer model used to project the effectiveness of each alternative.

WASP Computer Model

Modeling Mercury Transport and Transformation along the Sudbury River, with Implications for Regulatory Action (2010) – EPA/ORD (Athens)

- Volume 1: Mercury Fate and Transport

  (describes the "Base Case" also referred to Alternative 3A or MNR)

- Volume 2: Evaluating the Effectiveness of Different Remedial Alternatives to Reduce Mercury Concentrations in Fish

WASP Computer Model

- Originally focus of the model was Reach 3 and Reach 8 to investigate the distinctly different mechanisms controlling mercury uptake.
- Model was calibrated using site-specific biological, chemical and hydrological data collected over 2 years
- Does not include Reaches 2, 9, and 10; however results [of modeled reaches] are assumed to apply to these other reaches.

WASP Computer Model

- As with all computer models, there is a level of uncertainty attributable to:
  - Values used as boundary conditions
  - Repeated 2-year hydrological cycle
  - Shape of the river over various reaches
  - Rate constants (such as partition coefficients, methylation rate, sedimentation rate).

WASP Computer Model

- Remedial Alternatives were developed and evaluated using the WASP model
- Following are the general remedial actions that were evaluated:
  - No Action
  - Limited Action
  - Monitored and Enhanced Natural Recovery
  - In-situ Containment
  - Sediment Removal (Dredging)

Remedial Alternatives Summary
Nyanza Chemical Waste Dump Superfund Site
Operable Unit 4 - Sudbury River
Ashland, Massachusetts

		Sudbury River Reaches								
Alternatives	**Remedial Action**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Alternative 1	**No Action**	NA	NA	NA	NA	NA	NA	NA	NA	NA
Alternative 2	**Limited Action (LA)**	LA	LA	LA	LA	LA	LA	LA	LA	LA
Alternative 3A	**Sitewide Monitored Natural Recovery (MNR)**	MNR	MNR	MNR	NA	MNR	NA	LA	MNR	MNR
Alternative 3B	**Enhanced Natural Recovery in Reach 3 > 10ppm**	MNR	Thin Layer Placement	MNR	NA	MNR	NA	LA	MNR	MNR
Alternative 3C	**Enhanced Natural Recovery in Reaches 3, 4 and 6 > 2ppm**	MNR	Thin Layer Placement	Thin Layer Placement	NA	Thin Layer Placement	NA	LA	MNR	MNR
Alternative 4A	**In Situ Containment in Reach 3**	MNR	Capping	MNR	NA	MNR	NA	LA	MNR	MNR
Alternative 4B	**In Situ Containment in Reaches 3, 4 and 6**	MNR	Capping	Capping	NA	Capping	NA	LA	MNR	MNR
Alternative 5A	**Dredging > 10ppm in Reach 3**	MNR	Partial Removal	MNR	NA	MNR	NA	LA	MNR	MNR
Alternative 5B	**Dredging > 10ppm in Reach 3, In Situ Capping in Reaches 3, 4 and 6**	MNR	Partial Removal/ Capping	Capping	NA	Capping	NA	LA	MNR	MNR
Alternative 5C	**Dredging > 2ppm in Reach 3**	MNR	Removal	MNR	NA	MNR	NA	LA	MNR	MNR
Alternative 5D	**Dredging > 2ppm in Reaches 3, 4 and 6**	MNR	Removal	Removal	NA	Removal	NA	LA	MNR	MNR

Hg = total mercury

MeHg = methylmercury

mg/kg = milligrams per kilogram

MNR = Monitored Natural Recovery

Alternative 1 Summary

- Alternative 1 – No Action.

Reduction would occur through Natural Recovery processes although

No monitoring would occur to verify the rate of recovery or residual risk.

No Institutional Controls (ICs) such as advisories or public outreach

Alternative 2 Summary

- Alternative 2 – Limited Action.

  Reduction would occur through Natural Recovery processes (as with the No Action alternative)

  No monitoring would occur to verify the rate of recovery or residual risk.

  ICs such as maintaining fishing advisories and/or outreach **would** be conducted.

Alternative 3 Summary

- Alternative 3 – Monitored (3A) and Enhanced Natural Recovery (3B and 3C)

Reduction would occur through Natural Recovery processes (3A) and monitoring would occur to verify the rate of recovery and/or residual risk. ICs (support of advisories or outreach) would be conducted.

In the ENR variations, a thin-layer of sand would be added to the highest concentration of mercury in sediment.

Alternative 4 Summary

- Alternative 4 – In-Situ Containment (4A and 4B)

Active remediation consisting of the addition of AquaBlok®. Aquablok is a clay-based isolation barrier for remediation of contaminated sediments.

  - Alternative 4A evaluates its application to Reach 3
  - Alternative 4B evaluates its application in Reaches 3, 4 and 6.

This would supplement the natural recovery remedy at other reaches and monitoring would occur to verify the rate of recovery and/or residual risk. ICs (advisories and/or outreach) would be conducted.

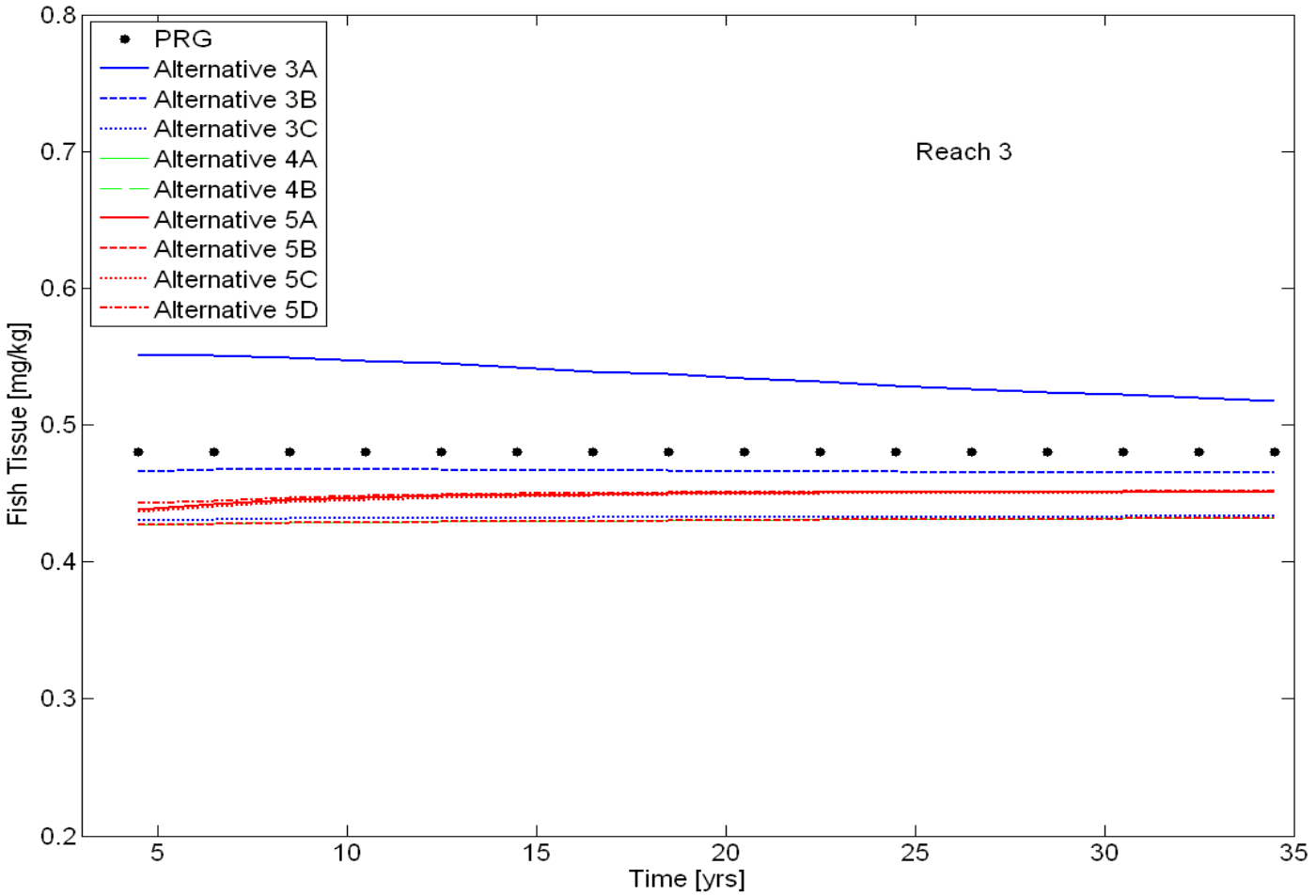
Alternative 5 Summary

- Alternative 5 – Sediment Removal (5A - 5D)
- Different variations of this technology were evaluated all of which assumed wet dredging methods were used.
  - Alternative 5A – Mercury > 10 ppm, portion of R3
  - Alternative 5B – Mercury >10 ppm, with capping R3,R4, R6
  - Alternative 5C – Mercury > 2 ppm, all of R3
  - Alternative 5D – Mercury > 2 ppm, R3, R4 and R6
- In addition the reduction via Natural Recovery in some reaches, additional reduction would be afforded by sediment removal. Monitoring would occur to verify the rate of recovery and/or residual risk. ICs (support of advisories or outreach) would be conducted
- Note: those alternatives which included Reach 6 were projected to increase fish–tissue in Reach 8 due to re-suspension and migration of mercury.

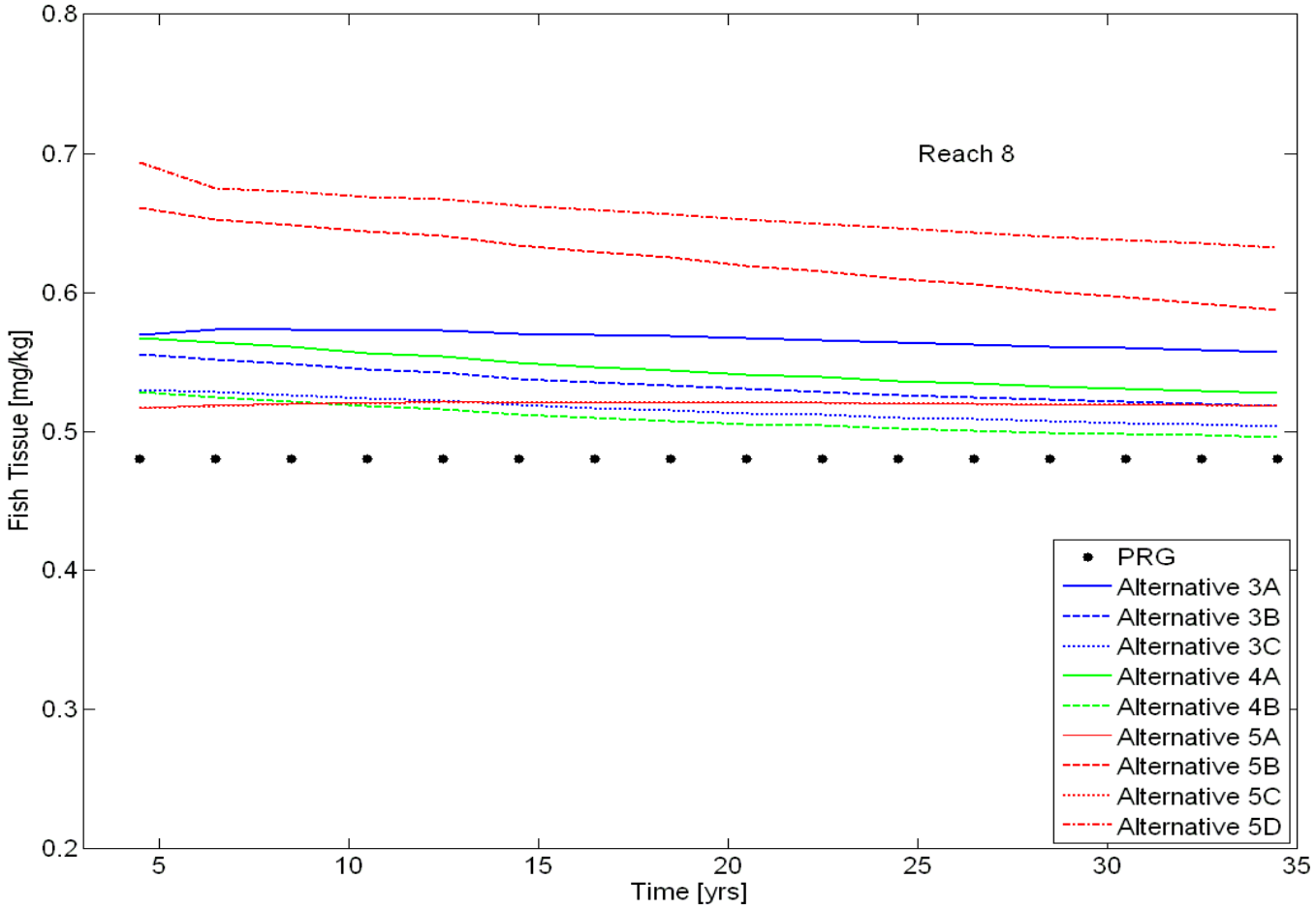
Evaluation Criteria

- Threshold Criteria
  - Protectiveness (human health and the environment)
  - Compliance with regulations
- Balancing Criteria
  - Implementability
  - Short term effectiveness
  - Long Term effectiveness
  - Reduction of toxicity, mobility, volume of contaminants
  - Cost
- Modifying Criteria (addressed after Public Comment)
  - State acceptance (pending)
  - Community acceptance (pending)

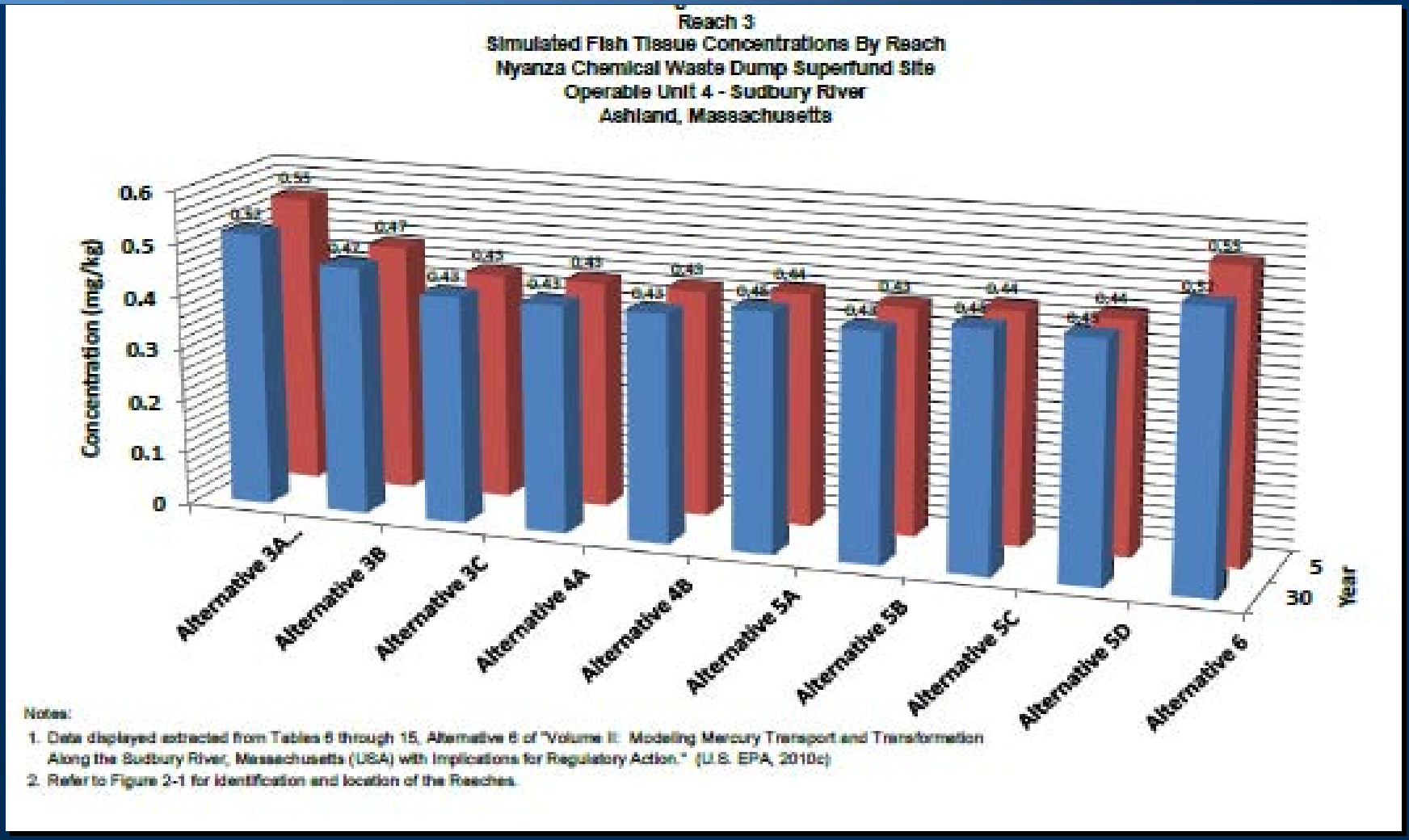
Model results



Model results



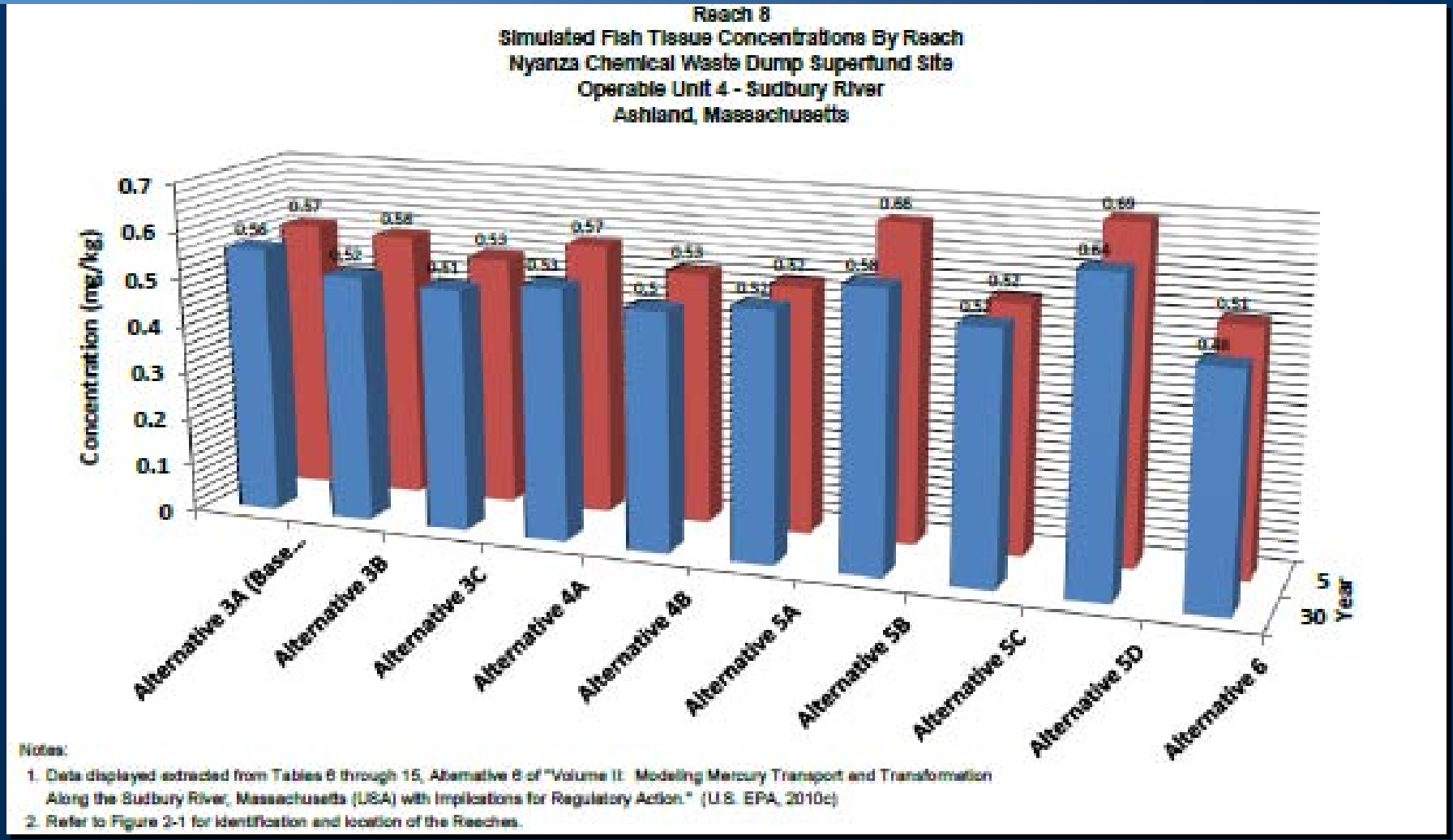
Reach 3 - Model Predicted Results



Notes:

1. Data displayed extracted from Tables 6 through 15, Alternative 6 of "Volume II: Modeling Mercury Transport and Transformation Along the Sudbury River, Massachusetts (USA) with Implications for Regulatory Action." (U.S. EPA, 2010c)
2. Refer to Figure 2-1 for identification and location of the Reaches.

Reach 8 - Model Predicted Results



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2. Refer to Figure 2-1 for identification and location of the Reaches.

FS Summary

- Model predicts Natural Recovery will achieve clean up goal (0.48 ppm) within 30 years for most reaches (except R3 and R8)

- Reach 8 (GMNWR) is not anticipated to substantially improve due to combination of anthropogenic (man-made) sources and unique hydrological properties of this 3,600-acre refuge which is efficient at methylating mercury.

FS Summary

- Enhanced Natural Recovery in Reach 3 only (Alternative 3B) is equivalent to 400 years of natural sedimentation and reduces timeframe to attain PRGs from > 70 years to less than 30 years.

- Other Alternatives (3C, 4A, 4B, 5A, and 5C) predicted to be similarly effective in reducing fish tissue concentrations (except Alternative 5B and 5D) at a greater cost.

Alternative Cost Summary

- ***Alternative 1: No Action***
  Alternative 1 Cost: *$ 0*

- ***Alternative 2: Limited Action***
  Alternative 2 Cost: *$ 192,000*

- ***Alternative 3: Monitored Natural Recovery and Enhanced Natural Recovery***
  Alternative 3A Cost: *$1,070,000*
  Alternative 3B Cost: *$8,500,000*
  Alternative 3C Cost: *$20,800,000*

- ***Alternative 4: In-situ Containment***
  Alternative 4A Cost: *$24,310,000*
  Alternative 4B Cost: *$48,910,000*

- ***Alternative 5: Sediment Removal***
  Alternative 5A Cost: *$59,710,000*
  Alternative 5B Cost: *$88,510,000*
  Alternative 5C Cost: *$99,820,000*
  Alternative 5D Cost: *$213,920,000*

Table 13-1
Alternatives Comparison
Nyanza Chemical Waste Dump Superfund Site
Operable Unit 4 - Sudbury River, Ashland, Massachusetts

	Alt. 1 No Action	Alt. 2 Limited Action	Alt. 3A Sitewide MNR	Alt. 3B ENR in Reach 3 > 10ppm	Alt. 3C ENR in Reaches 3, 4, 6 > 2ppm	Alt. 4A In Situ Containment in Reach 3	Alt. 4B In Situ Containment in Reaches 3, 4 and 6	Alt. 5A Dredging > 10ppm in Reach 3	Alt. 6B Dredging > 10ppm in Reach 3, In Situ Containment in Reaches 3, 4 and 6	Alt. 6C Dredging > 2ppm in Reach 3	Alt. 6D Dredging > 2ppm in Reaches 3, 4 and 6
Timeframe to Implement *	0 Years	2 Years	2 Years	3 Years	4 Years	3 Years	4 Years	3 Years	4 Years	4 Years	5 Years
Timeframe to Remediation Goals**	>70 Years	>70 Years	>70 Years	<30 Years	<30 Years	<30 Years	<30 Years	<30 Years	<30 Years	<30 Years	<30 Years
Comparison Criteria											
Overall Protectiveness	☒	✓	✓	☑	☑	☑	☑	☑	☑	☑	☑
Compliance with ARARs	☑	☑	☑	☑	✓	☑	✓	✓	✓	✓	✓
Long-Term Effectiveness	☒	✓	✓	☑	☑	☑	☑	☑	☑	☑	☑
Reduction of TMV	☒	☒	☒	✓	✓	✓	✓	✓	✓	✓	✓
Short-Term Effectiveness	☒	✓	✓	☑	☑	☑	☑	☑	☑	☑	☑
Implementability	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑
Cost (in Millions)	$0.0	$0.2	$1.1	$8.5	$20.8	$24.3	$48.9	$59.7	$88.6	$99.8	$213.6
State Acceptance	To Be Determined After Public Comment Period										
Community Acceptance	To Be Determined After Public Comment Period										

Notes:

Alt = Alternative

TMV = Toxicity, Mobility and Volume

☑ Meets Criteria

✓ Partially Meets Criteria

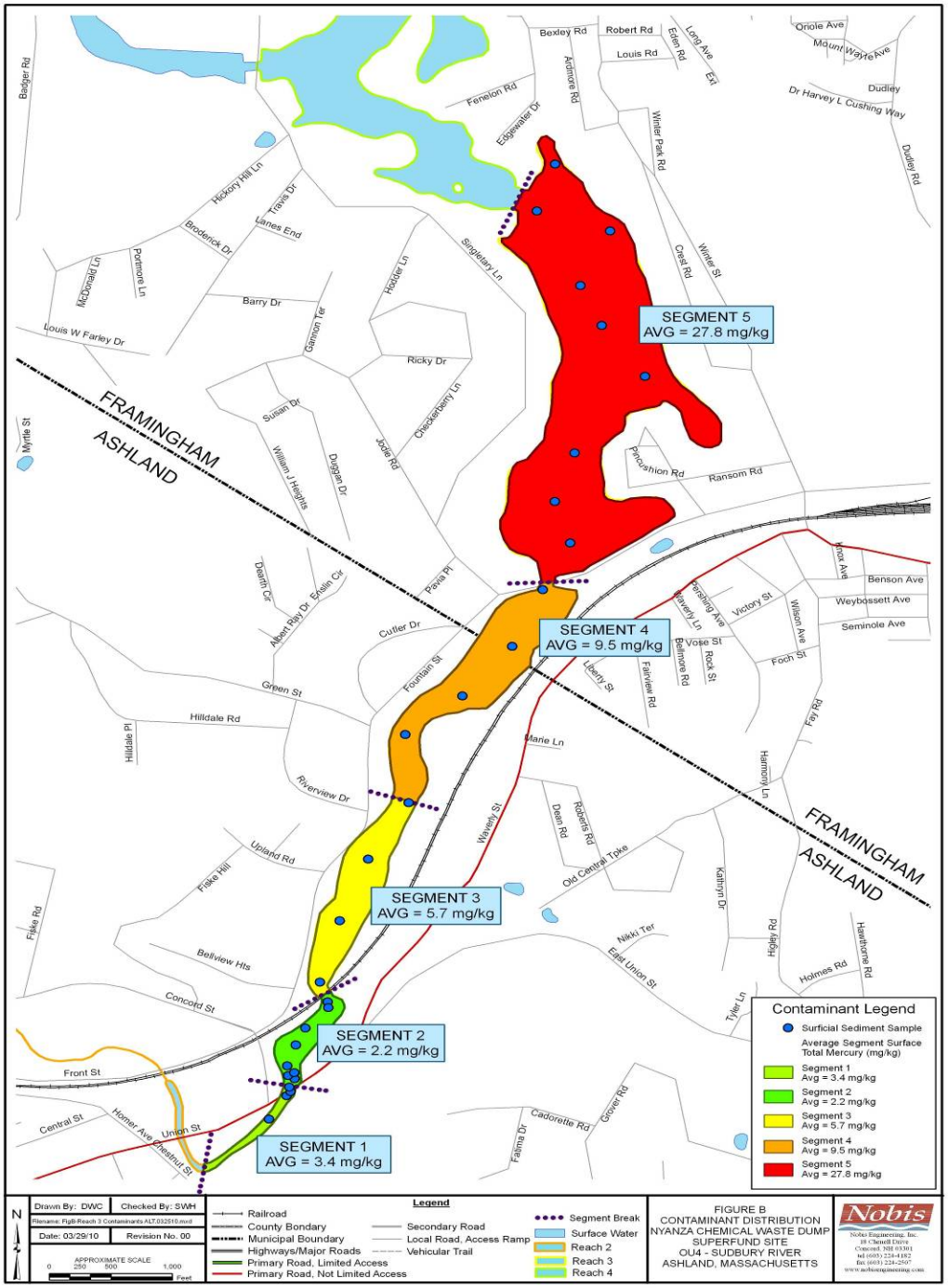
☒ Fails to Meet the Criteria

* Includes a 1 to 2 Year Period to Complete Remedial Design

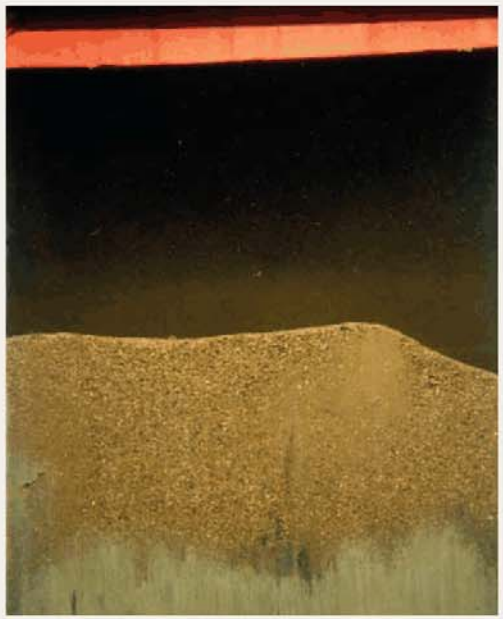
** Defined to mean attainment of both remedial action objectives: a) prevent consumption of contaminated fish through advisories; and b) reduction of mercury in fish to acceptable levels (except in Reach 8)

More about Alternative 3B (ENR)

- Provides a 6-inch layer of material at the sediment surface that results in the reduction of mercury in surface sediment.
- Includes monitoring to confirm that recovery is occurring.
- Accelerates the natural process of sedimentation and burial.
- Implemented with the recognition that biological or physical mixing of the cap with underlying sediment may occur.


SEGMENT 5
AVG = 27.8 mg/kg
SEGMENT 4
AVG = 9.5 mg/kg
SEGMENT 3
AVG = 5.7 mg/kg
SEGMENT 2
AVG = 2.2 mg/kg
SEGMENT 1
AVG = 3.4 mg/kg
FRAMINGHAM
ASHLAND
Contaminant Legend
Surficial Sediment Sample
Average Segment Surface Total Mercury (mg/kg)
Segment 1 Avg = 3.4 mg/kg
Segment 2 Avg = 2.2 mg/kg
Segment 3 Avg = 5.7 mg/kg
Segment 4 Avg = 9.5 mg/kg
Segment 5 Avg = 27.8 mg/kg
Legend
Railroad
County Bondary
Municipal Boundary
Highways/Major Roads
Primary Road, Limited Access
Primary Road, Not Limited Access
Secondary Road
Local Road, Access Ramp
Vehicular Trail
Segment Break
Surface Water
Reach 2
Reach 3
Reach 4
Drawn By: DWC
Checked By: SWH
Date: 03/29/10
Revision No. 00
APPROXIMATE SCALE
Feet
FIGURE B
CONTAMINANT DISTRIBUTION
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE
OU4 - SUDBURY RIVER
ASHLAND, MASSACHUSETTS
Nobis
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
tel (603) 224-4182
fax (603) 224-2507
www.nobisengineering.com

Thin–layer sand caps



Thin Layer Caps of Varying Grain Size

Photos courtesy of Germano & Associates, Inc.

Drawn By: DWC	Checked By: SWH
Filename: FigC1-Reach 3 Detail ALT.033010.mxd	
Date: 03/29/10	Revision No. 00

APPROXIMATE SCALE
0 250 500 1,000

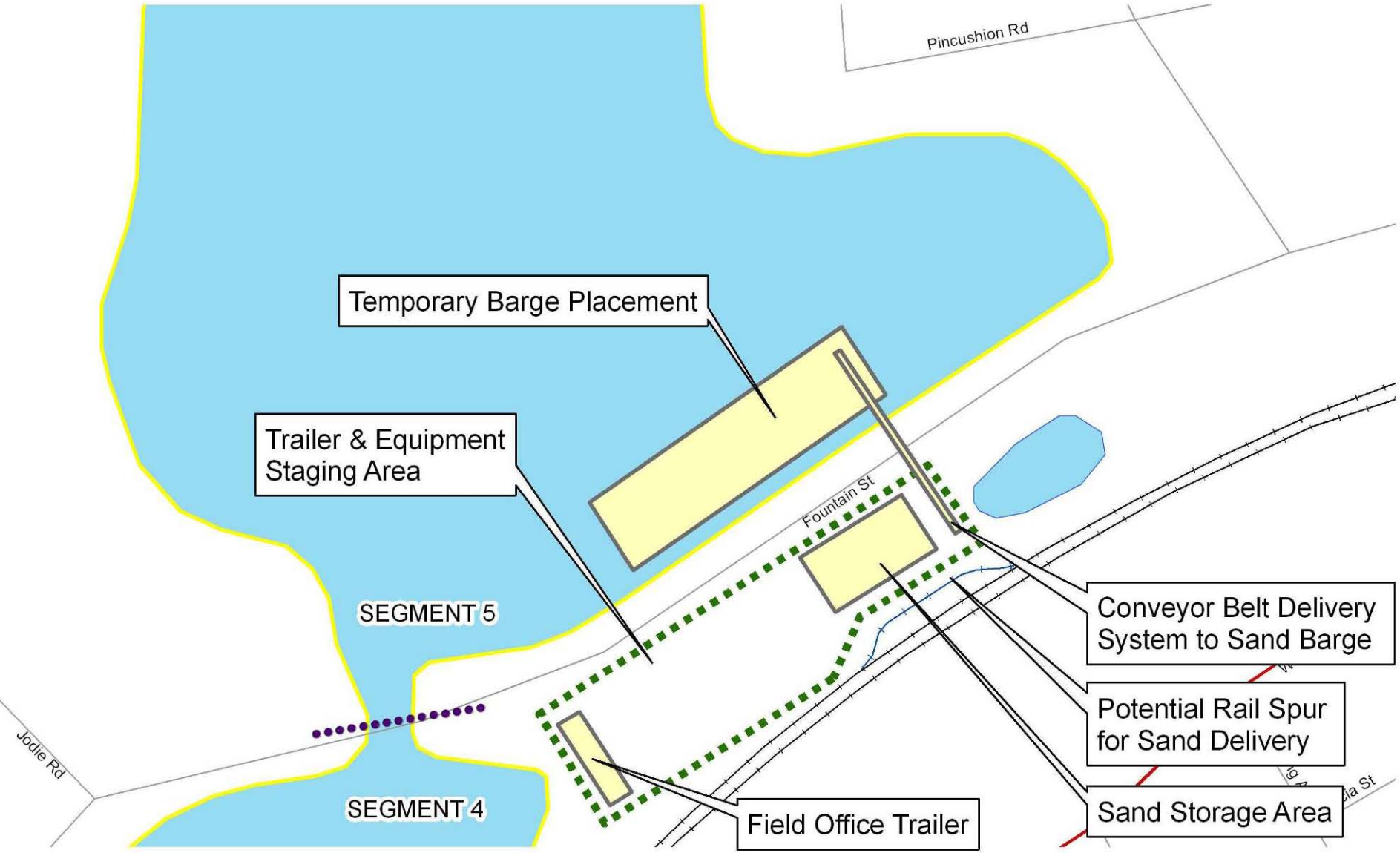
Legend

- Railroad
- County Bondary
- Municipal Boundary
- Highways/Major Roads
- Primary Road, Limited Access
- Secondary Road
- Local Road, Access Ramp
- Vehicular Trail
- Segment Break
- Surface Water
- Reach 2
- Reach 3

FIGURE C-1
POTENTIAL STAGING AREA DETAIL
REACH 3 SEGMENTS
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE
OU4 - SUDBURY RIVER

Nobis
Nobis Engineering, Inc.
18 Chenell Drive
Concord, NH 03301
tel (603) 224-4182

AREA OF DETAIL: POTENTIAL STAGING AREA



Drawn By: DWC	Checked By: SWH
Filename: FigC2-Reach 3 Detail ALT.033010.mxd	
Date: 03/29/10	Revision No. 00

APPROXIMATE SCALE
0 100 200
Feet

Legend

- Railroad
- County Bondary
- Municipal Boundary
- Highways/Major Roads
- Primary Road, Limited Access
- Primary Road, Not Limited Access
- Secondary Road
- Local Road, Access Ramp
- Vehicular Trail
- Segment Break
- Surface Water
- Reach 2
- Reach 3
- Reach 4

FIGURE C-2
POTENTIAL STAGING AREA DETAIL
REACH 3 SEGMENTS
NYANZA CHEMICAL WASTE DUMP
SUPERFUND SITE
OU4 - SUDBURY RIVER
ASHLAND, MASSACHUSETTS

Nobis
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Concord, NH 03301
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How to Comment

- Public Comment Period begins

  June 25, 2010 and ends July 26, 2010
  - Submit comments in writing by letter, fax, or email

- Public Hearing July 19, 2010
  - At the Framingham Public Library (*Note change date and location)
  - Verbal comments will be transcribed

Where to Comment

- Submit Comments by midnight 7/26/2010 to:

Dan Keefe
EPA - New England, Region 1
5 Post Office Square
Suite 100
Boston, MA 02109-3912

Or by email to:

Email : keefe.daniel@epa.gov
Fax: 617-918-0327

EPA will respond in writing to all comments.

QUESTIONS